



Application Date: Dec. 22, 1944. No. 25228/46.

[Divided out of No. 581,410].

Complete Specification Accepted: Jan. 31, 1947.

COMPLETE SPECIFICATION

Curing of Polymeric Materials.

We, DAVID AUGUSTINE HAKPER and
WALTER FAIRBAIRN SMITH, both of
Hexagon House, Blackley, Manchester,
British Subjects, and IMPERIAL CHEMICAL
INDUSTRIES LIMITED, of Imperial
Chemical House, Millbank, London,
S.W.1: a Company incorporated under the
laws of Great Britain, do hereby declare
the nature of this invention and in what
manner the same is to be performed, to
be particularly described and ascertained
in and by the following statement:—

This invention relates to the curing of
polymeric materials more especially to
the curing of organic diisocyanate modi-
fied poly-esteramides in admixture with
other polymeric materials.

In Application numbered 19204/41
(Serial No. 580,524) it has been proposed
to cure organic diisocyanate modified
polyester-amides by heating these in the
presence of formaldehyde or of a form-
aldehyde-liberating substance, and pre-
ferably, also in the presence of materials
which function as curing catalysts, for
example, formic, glycolic, oxalic,
succinic, maleic, adipic, tartaric, salicylic,
anthranilic, phthalic, citric, boric and
phosphoric acids, phthalic and maleic
anhydrides, phthalimide and potassium
or sodium dihydrogen phosphate.

In Application numbered 7392/42
(Serial No. 580,526) it has been proposed
to cure organic diisocyanate modified poly-
ester-amides by heating these in the
presence of formaldehyde or of a form-
aldehyde-liberating substance and also in
the presence of curing catalysts which are
substantially neutral but which develop
acidity only under curing conditions, for
example, butadiene sulphone, 2:3-di-
methylbutadiene sulphone, butadiene-
tetrabromide, styrenedibromide, acetylene
tetrabromide, tribromohydroquinone, 1-
bromo-2-naphthol, 1:6-dibromo-2-
naphthol, 1:4:6-tribromo-2-naphthol,
2:4-dibromo-1-naphthol, methyl- α : β -
dibromopropionate, β -chloroethyl- α : β -
dibromoisobutyrate, ethyl α -bromo-pro-
pionate, phenyl trichloroacetate, α : β -
trichloropropionitrile, trichloroacetamide,
trichloroacetyldiethylamide, N-trichloro-
acetylanilide, N:N'-di(trichloroacetyl-
methylenediamine, N:N'-di(trichloro-
acetyl)ethylenediamine, interpolymers of
asymmetrical dichloroethylene and vinyl
chloride, and chloranil tetrachloro-p-
benzoquinone).

In Application numbered 10290/43
(Serial No. 581,146) it has been proposed
to use dichromates for curing organic di-
isocyanate modified polyester-amides.

We have now found that the organic
diisocyanate modified polyester-amides
may be cured, with advantage, together
with small or large proportions of other
polymeric materials which are themselves
reactive to formaldehyde and/or di-
chromates.

According to the present invention in
the curing of organic diisocyanate modi-
fied polyester-amides in the manner
hereinafter set forth we provide the
improvement which comprises curing said
modified polyester-amides in uniform
admixture with a proportion of a deriva-
tive of cellulose.

The invention also comprises heat-cur-
able compositions comprising as the
essential ingredients an organic diiso-
cyanate modified polyester-amide, a pro-
portion of a derivative of cellulose, and
one or more materials of the kind herein-
after set forth such as are customarily
used for curing organic diisocyanate
modified polyester-amides.

Water-soluble or water-insoluble deriva-
tives of cellulose include cellulose esters,
for example, cellulose nitrate and cellu-
lose acetate, and cellulose ethers such as
benzyl cellulose. These materials are
modified by the action of formaldehyde
thereon, and they are compatible with the
organic diisocyanate modified polyester-
amides, in the sense that they are capable
of forming homogeneous blends there-
with.

The derivative of cellulose may be
brought into uniform admixture with the
organic diisocyanate modified polyester-
amide in several ways. For instance, a
derivative of cellulose dissolved in water
is slowly added to an organic diisocyanate
modified polyester-amide running on a
warm rubber mill. Or, a derivative of
cellulose in powder form, is milled into an

organic diisocyanate modified polyester-
amide on a rubber mill; a sufficiency of
water usually being added to render the
mix soft. When water is used before or
during the incorporation, the mix is
usually milled until it is substantially
dry, the rolls, if hot, being preferably
allowed to cool during the drying so as to
minimise the risk of the mix sticking
thereto. Alternatively, the components
are mixed or milled together (in the
absence of water) as such or in the
presence of organic liquids which are sol-
vents for one or more of the materials; the
organic liquids are removed as and when
convenient.

The proportions of the components are
not critical, but usually from about 25 to
175 parts of the derivative of cellulose per
100 parts of organic diisocyanate modified
polyester-amide are used.

The mixtures are cured by means of
any of the materials customarily used for
curing organic diisocyanate modified
polyester-amides, that is to say, by heat-
ing with a known curing agent, namely,
formaldehyde or a formaldehyde-liberat-
ing substance or a dichromate; preferably
in the presence of a known curing cata-
lyst, namely, an acid or a material which
is substantially neutral but which
develops acidity under curing conditions.
These ingredients required for curing are
incorporated with the mix whenever con-
venient but, if water has been used to
assist in the formulation of the mix, pre-
ferably after the mix is dried.

As well as those already mentioned, one
or more additional compounding ingre-
dients may also be used. These include
fillers, for example, carbon black, iron
oxide, clay, asbestos, blanc fixe, whiting,
lithopone and mica; resins, for example,
urea-formaldehyde and phenol-formalde-
hyde resins; other plastic materials, for
example, natural or synthetic rubbers,
vulcanised vegetable oils, dark substitute,
white substitute, a Cumar resin, wood
rosin and pitch; de-tackifying agents,
that is to say, materials which reduce the
tendency of the mix to stick to the rolls,
for example, stearic acid, paraffin wax,
oleic acid, lauric acid and dibutyl
ammonium oleate; plasticisers, for
example, tricresyl phosphate, dibutyl
phthalate, butylphthalyl, butyl glycol-
late, and *N*-alkyl-toluenesulphonamides;
stabilisers or anti-oxidants, for example,
hydroquinone, *N*:*N'*-hexamethylene-bis-
ortho-hydroxy-benzamide, *N*-phenyl- α -
naphthylamine, *N*-phenyl- β -naphthyl-
amine and *a,a*-bis(2-hydroxy-3:6-
dimethylphenyl)butane, as well as others
commonly used in rubber technology.
Small quantities of pigments, for example

from 1-3% by weight, such as are
customarily used in rubber technology or
in the coating composition art may also be
used to impart colour. The use of alkaline
reacting compounding ingredients should
be avoided since these may cause degrada-
tion of the polymeric materials.

When the ingredients are mixed, the
mix is removed from the mill or mixer, if
desired, formed into shapes or spread or
calendered on to a substrate, for example
on to the surface of a fabric, or on to the
surface of a coated fabric and then curing
is effected by heating, for example, in a
mould which is preferably in a hydraulic
press, or in hot air. Periods of heating
varying from a few minutes to several
hours at 100-150° C. are usual. If
desired, to facilitate shaping or spreading,
organic solvents or swelling agents or
additional solvents or swelling agents
may be incorporated with the materials;
these are removed as and when convenient.

Suitable organic solvents include
acetone, mixtures of benzene and acetone,
mixtures of benzene and ethanol, mixtures
of benzene and chloroform, mixtures of
benzene and methylethyl ketone, mixtures
of methyl ethyl ketone and trichloro-
ethylene, and mixtures of acetone and the
monoethyl ether of ethylene glycol.

Polyester- and polyamide-forming
reactants suitable for making the diiso-
cyanate modified polyester-amides to be
used for the purposes of the present inven-
tion include glycols, for example,
ethylene glycol, diethylene glycol, tri-
methylene glycol, pentamethylene glycol,
hexamethylene glycol, dodecamethylene
glycol, 1:12-octadecanediol and penta-
glycol; aliphatic or aromatic amino-
alcohols having at least one hydrogen
atom attached to the amino nitrogen atom
and preferably containing an aliphatic
chain of at least two carbon atoms separat-
ing the amino and hydroxyl groups, for
example β -ethanolamine and 3-amino-
propanol; dibasic carboxylic acids or ester-
forming derivatives thereof, preferably
aliphatic dicarboxylic acids, for example,
malonic, succinic, glutaric, adipic, β -
methyladipic, pimelic, sebacic, azelaic,
undecanedioic, brassylic, iso-
phthalic, hexahydroterephthalic, *p*-
phenylenediacetic, and acetone-dicarb-
oxylic acids; primary and secondary
diamines, for example, ethylene diamine,
hexamethylenediamine, 3-methylhexa-
methylenediamine, decamethylenedi-
amine, *m*-phenylenediamine, *N*:*N'*-di-
ethylhexamethylenediamine, *N*:*N'*-di-
ethylhexamethylenediamine, and *N*:*N'*-
dimethyldecamethylenediamine; mono-
hydroxy monocarboxylic acids or their
ester-forming derivatives, for example, 180

glycollic, 6-hydroxycaproic, 10-hydroxy-decanoic and 12-hydroxystearic acids; polymerizable monoaminomonocarboxylic acids, or their ester-forming derivatives; for example, 6-aminocaproic acid or its lactam, caprolactam, and 9-amino-nonanoic, 11-aminoundecanoic and 12-aminostearic acids.

The polyester-amides are made in known manner by heating the selected reactants at polymerizing temperatures, usually in the absence of air or oxygen, under conditions whereby water is removed from the reaction mixture. When a diamine is to be used, it is conveniently used in the form of the corresponding diammonium salt from some of the dibasic carboxylic acid to be used.

The polyester-amides are modified with organic diisocyanates in known manner for example, by mixing them, for example by stirring, milling or kneading, with the organic diisocyanate and then heating the mixture, for example, to a temperature of 100–200° C. for a period of 10–720 minutes. Up to about 10 per cent., usually 3–7%, by weight of the diisocyanate is used.

Examples of organic diisocyanates includes ethylene diisocyanate, trimethylene diisocyanate, tetramethylene diisocyanate, hexamethylene diisocyanate, decamethylene diisocyanate, *p*-phenylene diisocyanate, *m*-phenylene diisocyanate, *p*:*p*'-diphenyl diisocyanate, diphenylmethane-4:4'-diisocyanate, naphthalene diisocyanates and adipyl diisocyanate.

The new heat-curable compositions of the invention may be used in the fabrication of a variety of articles, in which they may or may not be supported on a substrate, and/or interspersed with fillers. For instance, they may be used in the construction of organic liquid resistant articles of all kinds, for example, gaskets, packings, hose, diaphragms for pumps and the like, as well as in the fabrication of flexible containers. They may also be used in the coating of rollers, blankets and stencils for use in the printing industry, or to provide protective sheathings for insulated electric cables and other electrical conductors. They also find application in the coating of the balls for games, tyres and flexible materials generally, including fabrics, protective clothing, leather cloth and floor coverings, and generally in the construction of articles requiring the use of a material having physical properties resembling those of rubber, but also having a good resistance to the action of organic fluids and a low permeability to gases and vapours.

They are well adapted for application in the form of lacquers or finishing com-

positions for all kinds of surfaces. They may be formed into films or sheets, for example, as substitutes for leather or as wrapping films, and they may be used as adhesives for a wide variety of materials, for example, wood, metals, fabrics, paper, leather and regenerated cellulose.

The invention is illustrated but not limited by the following Examples, in which the parts and percentages are expressed by weight, unless otherwise stated:—

EXAMPLE 1.

Into 100 parts of an organic diisocyanate modified polyester-amide there are milled 10 parts of titanium dioxide, 5.0 parts of hexamethylolmelamine hexamethyl ether and 0.75 parts of 2:4-dichloro-1-naphthol. The mix is then let down in 100 parts of a mixture of equal volumes of benzene and acetone, and 125 parts of a 20% solution of cellulose acetate (acetone-soluble) are stirred in. The mix is thinned with acetone to a solids content of 10–15% and is ready for use.

The composition is flowed on to a glass plate, the solvent is allowed to evaporate, and the so obtained film is cured by heating in air at 125° C. for 2 hours.

The cured film is tough and has a rubbery handle; its surface is very resistant to scratching.

When the recipe of the Example is repeated using twice the quantity of the solution of cellulose acetate, a film is obtained which is tougher, less rubbery, harder, and extremely resistant to scratching.

Similarly, when the recipe of the Example is repeated using three times the quantity of the solution of cellulose acetate, there is an increase of toughness and hardness, and a decrease of rubbery properties; the film has outstanding resistance to scratching.

EXAMPLE 2.

Into 100 parts of an organic diisocyanate modified polyester-amide there are milled 10 parts of titanium dioxide, 5.0 parts of hexamethylolmelamine hexamethyl ether and 0.75 parts of 2:4-dichloro-1-naphthol. The mix is let down in 100 parts of a mixture of equal volumes of benzene and acetone, and 250 parts of a 20% solution of nitrocellulose obtainable commercially under the name "Colloidon Cotton HX 80/50" are stirred in. The mix is thinned with acetone to a solids content of 10–15% and is ready for use.

The composition is flowed on to a glass plate, the solvent is removed by evaporation, and the so obtained film is cured by heating in air at 125° C. for 2 hours.

The cured film is tough, rubbery and

has a very good scratch resistance.

When the recipe of the Example is repeated using half as much again of the nitrocellulose solution, a tougher, less rubbery film with better scratch resistance is obtained.

EXAMPLE 3:

A lacquer is prepared by mixing together 100 parts of an organic diisocyanate modified polyester-amide, 60 parts of the cellulose acetate used in Example 1, 10 parts of carbon black, 5 parts of hexamethylmelamine hexamethyl ether, 0.75 parts of 2:4-dichloro-1-naphthol, 200 parts of ethylene glycol monoethyl ether and 350 parts of acetone.

The so obtained lacquer is used to provide a top-coating for the hydrolysed leather-organic diisocyanate modified polyester-amide coated fabric obtained in the manner set forth in Application numbered 24389/43 (Serial No. 583,882), and more specifically as follows:—

180 parts of disintegrated scrap vegetable-tanned leather are mixed with sufficient cold water to form an easily stirred slurry, the slurry is heated up to boiling and boiled for about 5 minutes. The leather settles in the form of a crumbly mass from which the liquid is poured off. The wet mass is added in small amounts to 100 parts of an organic diisocyanate modified polyester-amide running on a rubber mill with the rolls heated to about 70° C.; the mix is milled until homogeneous, and then dried on the rolls. The following ingredients are then added in the order listed, 0.5 parts stearic acid, 30 parts of titanium dioxide, 5 parts of hexamethylmelamine hexamethyl ether and 0.75 parts 2:4-dichloro-1-naphthol, milling is continued until the mix is again homogeneous, and it is then sheeted off the mill.

The sheet is added to its own weight of a benzene-ethanol mixture (75:25 by volume) in a Werner Pfeiderer mixer, and mixed until a smooth dough is

obtained. The dough is spread on to a cotton twill fabric, the organic liquids are allowed to evaporate.

The coated spreading is then cured by heating in air at 125–130° C. for 2 hours.

The cured material has a high gloss, an excellent abrasion, scrub and flex resistance, and an outstanding resistance to scratching or marking.

The organic diisocyanate modified polyester-amide used in the above Examples is that described in Example 7 of Application numbered 13204/41 (Serial No. 580,624).

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. In the process of curing organic diisocyanate modified polyester-amides in the known manner hereinbefore set forth, the improvement which comprises curing said modified polyester-amides in uniform mixture with a proportion of a derivative of cellulose.

2. The improvement which comprises curing organic diisocyanate modified polyester-amides in uniform admixture with a proportion of a derivative of cellulose in the manner hereinbefore particularly described and ascertained especially with reference to the foregoing Examples.

3. Organic diisocyanate modified polyester-amides whenever cured in uniform admixture with a proportion of a derivative of cellulose according to either of the preceding claims.

4. Heat-curable compositions comprising as the essential ingredients an organic diisocyanate modified polyester-amide, a proportion of a derivative of cellulose, and one or more materials of the kind hereinbefore set forth such as are customarily used for curing organic diisocyanate modified polyester-amides.

Dated the 28th day of September, 1945.

J. W. RINDALE,
Solicitor for the Applicants.

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PATENT SPECIFICATION

599,793



Application Date: March 7, 1944. No. 4257/44.

Complete Specification Left: June 19, 1944.

Complete Specification Accepted: March 22, 1948.

PROVISIONAL SPECIFICATION

Improvements in or relating to Walls, Roofs, Floors, and Ceilings

We, HENRY WYNMALEN, a subject of the Queen of the Netherlands, and JOHN WELLINGS POWELL, a subject of the King of Great Britain, both of Hare Hatch Estate Office, Twyford, Berkshire, do hereby declare the nature of this invention to be as follows:—

This invention relates to walls, roofs, floors, and ceilings, its chief object being to provide pre-fabricated panel units which can be built up into a building, or form the external walls of a building, without the employment of visible fastening devices exposed to the weather. Another object is to enable cavity walls, roofs, floors, and ceilings to be constructed of similar pre-fabricated units, while minimising the employment of skilled labour.

The said unit panel may be made of metals, metal alloys, pressed or cast or wrought, protected metal, asbestos cement, or combinations of metals and cement products, including such as concrete and reinforced concrete, and combinations of metals and woods, plywoods, insulation boards or slabs, plaster boards and like building materials commonly used for cladding or lining buildings.

According to the invention each unit panel is provided at its upper and lower ends, and in some cases at one or both sides also, with clips adapted to interlock with adjacent units, and with channel shaped joists, purlins, or other structural members.

The clip at the upper or leading end of a panel may be a hook or hook-shaped rib extending above the main body of the panel, while the clip at the lower or following end may be a hook or hook-shaped

rib the main portion of which is reverted or bent into a position parallel with the general plane of the panel, then turned over to form the hook. At one side of the panel there may be a hook or hook-shaped rib starting in the general plane of the panel, and at the other side a bevelled projection turned at a right angle to the said general plane. These clips besides engaging adjoining units are adapted to engage channel shaped joists and purlins in the structure of the building, and units of similar shape can be used for both upper and lower, or inner and outer surfaces.

At the apex of the roof, inner and outer caps are similarly provided with clips of hook shape in cross section to engage the clips at the tops of the adjacent inclined roof sheets. At the eaves, suitably curved members are provided with clips to engage the tops of the wall units and the bottoms of the lower roof units.

The shapes of the clips at the upper and lower floors may be modified as required.

Wall cladding or lining embodying this invention can be very quickly assembled when the lower units have been placed in position, and can be quickly dismantled by removing first the highest units and then the lower units.

Dated this 7th day of March, 1944.

HASELTINE, LAKE & CO.,
28, Southampton Buildings,
London, England,

and
19—25, West 44th Street, New York,
U.S.A.,

Agents for the Applicants.

COMPLETE SPECIFICATION

Improvements in or relating to Walls, Roofs, Floors, and Ceilings

We, HENRY WYNMALEN, a subject of the Queen of the Netherlands, and JOHN WELLINGS POWELL, a subject of the King of Great Britain, both of Hare Hatch Estate Office, Twyford, Berkshire, do hereby declare the nature of this inven-

tion and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to walls, roofs, floors and ceilings, its chief object being

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to provide pre-fabricated panel units which can be built up into a building, or form the walls or roofing of a building, without the employment of visible fastening devices, which in the case of external walls or roofing, would be exposed to the weather. Another object is to enable cavity walls, roofs, floors, and ceilings to be constructed of similar pre-fabricated units, while minimising the employment of skilled labour. Another object is to provide a vertical side joint between the panels which shall be weather-tight and act as an expansion joint, so remaining an efficient joint indefinitely, being thus distinguished from the usual form of joint now used between pre-fabricated panel units where some form of mastic is used to make the joint, which in the course of time after a number of cycles of expansion and contraction ceases to be efficient.

The said unit panel may be made of metals, metal alloys, pressed or cast or wrought, protected metal, asbestos-cement, or of wood, plywood, plastics, or laminated plastic products, or combinations of metals and cement products, including such as concrete and reinforced concrete, and combinations of metal and woods, plywoods, insulation boards or slabs, plaster boards, plastics or laminated plastics, and like building materials which may be used for cladding or lining buildings.

According to the invention each unit panel is provided at its upper or leading end and at its lower or following end with integral or permanently attached clips or flanged members adapted by rectilinear movement of the panel in its own plane and perpendicular to the end carrying the clips or flanged members to be interengaged tightly with adjacent units, or with the clips or members of adjacent units, and with the flanges of joists, purlins, or of other structural members.

The clip at the upper or leading end of a panel may be a resilient hook or hook-shaped rib extending along or near the upper edge of the panel, to grip a supporting rail or member, while the clip at the lower or following end may be a hook or hook-shaped rib the main portion of which is reverted or bent into a position parallel with the general plane of the panel, then turned over to form the hook, which is sprung over the top hook of a lower panel. At one side of the panel there may be a hook or hook-shaped rib starting in the general plane of the panel, and at the other side a bevelled projection turned at a right angle to the said general plane. These clips besides engaging adjoining units are adapted to engage joists and purlins in the structure of the build-

ing, and units of similar shape can be used for both upper and lower, or inner and outer surfaces. The clips may be of the same material as the panels or of other material, and if not formed integrally with the panel, may be attached thereto by welding or any other suitable means.

At the apex of the roof, inner and outer caps are similarly provided with clips of hook shape in cross section to engage the clips at the tops of the adjacent inclined roof sheets. At the eaves, suitably curved members are provided with clips to engage the tops of the wall units and the bottoms of the lower roof units.

The shapes of the clips at the upper and lower floors may be modified as required.

Wall cladding or lining embodying this invention can be very quickly assembled when the lower units have been placed in position, and can be quickly dismantled by removing first the highest units and then the lower units.

In order that the said invention may be clearly understood and readily carried into effect the same will now be further described with reference to exemplifications illustrated in the accompanying drawings, wherein:—

Figures 1, 2 and 3 are respectively a plan, sectional side view, and lower end view of a unit panel suitable for use in external roofing.

Figure 4 represents a portion of a roof constructed in accordance with the invention.

Figure 5 is a cross sectional view illustrating particularly the manner of using the unit panels for the construction of internal and external walling surfaces with cavities between them.

Figure 6 is a cross sectional view illustrating cavity walling and a cavity between a ceiling and an upper floor.

Figure 7 is a fragmentary view illustrating interlocking clips of slightly modified form.

Figure 8 represents a further modification, showing two clips engaging a joint or other constructional building member.

In the drawings, A in Figure 1 indicates a panel provided with an upper or leading clip *a*, a lower or following clip *b*, and on the external units a turned up lip *c* and a roll *d*.

As shown in Figure 4, the units are placed in position on roof structural members *e* such as purlins of channel form. Internal units B differing from the external units by the omission of the lip *c* and roll *d* may be used to form with the external units a cavity roof, and similar units B may be used for the upper and lower surfaces of a horizontal ceiling.

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thus forming a cavity ceiling. The ridge cap *f* and closing element *g* at the apex of the lining are also provided with clips of the form already designated by the reference letter *b*. The joists *h* support the ceiling panel units and a closing element having at each end clips *b*.

In Figure 5 the clips *a* and *b* are supported on structural members *k*. Some of the units are modified in shape to adapt them to particular positions, the unit *l* being curved to serve as a transition from the internal wall face to the internal roof slope lining, *m* being an external eaves unit, *n* an external weathering apron, and *p* an internal skirting unit, the shapes of all these being modified as may be required.

In the arrangement represented in Figure 6, *o* indicates the top of a foundation or of a masonry, brick or concrete wall above which the described cladding is begun; *q* indicates cavities in the wall, *r* a cavity between a ceiling and an upper floor, *s* a lower floor, which may also be made a cavity by adding lower panels. The panels may be constituted of flat sheets *t* of wood, plywood, asbestos-cement, or various building boards or slabs of insulating material or plastic or laminated plastic to which the clips *a* and *b* are secured by any suitable means. The clips may be made in any suitable material such as wood, or in cast, extruded, drawn or pressed metal profiles, as for example *u* on the bottom edge and *v* at the top edge of an external unit of the wall, *w* at the bottom edge and *x* at the top edge of an internal unit. The floor unit panels *s* may be covered with attached floor surfacing *y*, such as linoleum, a composition material, plywood or boards, or other suitable floor covering material. The ceiling unit panels *z* may have attached surfacing *z'*, which may be plywood, plaster-board, fibre board, acoustic board, or other suitable material.

The side joints of these units may be formed in a variety of ways, first as already mentioned the roof cladding side joint may be effected by means of an up-standing lip *c* and companion roll *d*. Other methods are such as plain overlapping, joggle overlapping or halving lap after the fashion of interlocking tiles, any or all such methods being associated with the said clip forms *a* and *b*; or the side joint may follow the special form already described for the upper and lower clip form *a* and *b* respectively where *a* nests into *b* which embraces *a* and so forms an inter-engaging mutually supporting side joint, and may if desired be caused to engage with structural members at right

angles to the structural members already referred to such as *e*, *h*, *k*, and so become supported by the structural members on all four edges of the unit panels perimeter.

By the use of this invention, the piercing of holes in metal or other roofing, or walling sheets for the purpose of fixing bolts and nuts is eliminated, as is also the need for using bolts, screws, or nails for the purpose of fixing. Such piercing tends to cause deterioration of the sheets, and detracts from their weather-proof qualities.

Although the entire surface of the wall or roof is completely inter-engaged, one unit with all its neighbouring units, the processes of assembling and dismantling the units made according to the invention can be carried out with great rapidity.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A unit panel for use in the construction of walls, roofs, floors, and ceilings, provided at its upper or leading end and at its lower or following end with integral or permanently attached clips or flanged members, adapted by rectilinear movement of the panel in its own plane and perpendicular to the end carrying the clips or flanged members, to be inter-engaged tightly with adjacent units or with the clips or flanged members of adjacent units, and with the flanges of joists, purlins, or of other structural members.

2. A unit as in Claim 1, which is also provided at one or both sides with members adapted to inter-engage with adjacent units.

3. Cavity floors and ceilings constructed of units as in Claim 1 or of units as in Claim 2, or of units as in Claim 1 and Claim 2 in combination.

4. Cavity walls and roofs constructed of internal panel units as in Claim 1 or Claim 2 and external panel units as in Claim 2.

5. Walls, roofs, floors, and ceilings constructed of panel units substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 19th day of June, 1944.

HASELTINE, LAKE & CO.,

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London, England,

and

19—25, West 44th Street, New York, 18,
U.S.A.,

Agents for the Applicants.

599,793 COMPLETE SPECIFICATION

SHEET 1

[This Drawing is a reproduction of the Original on a reduced scale.]

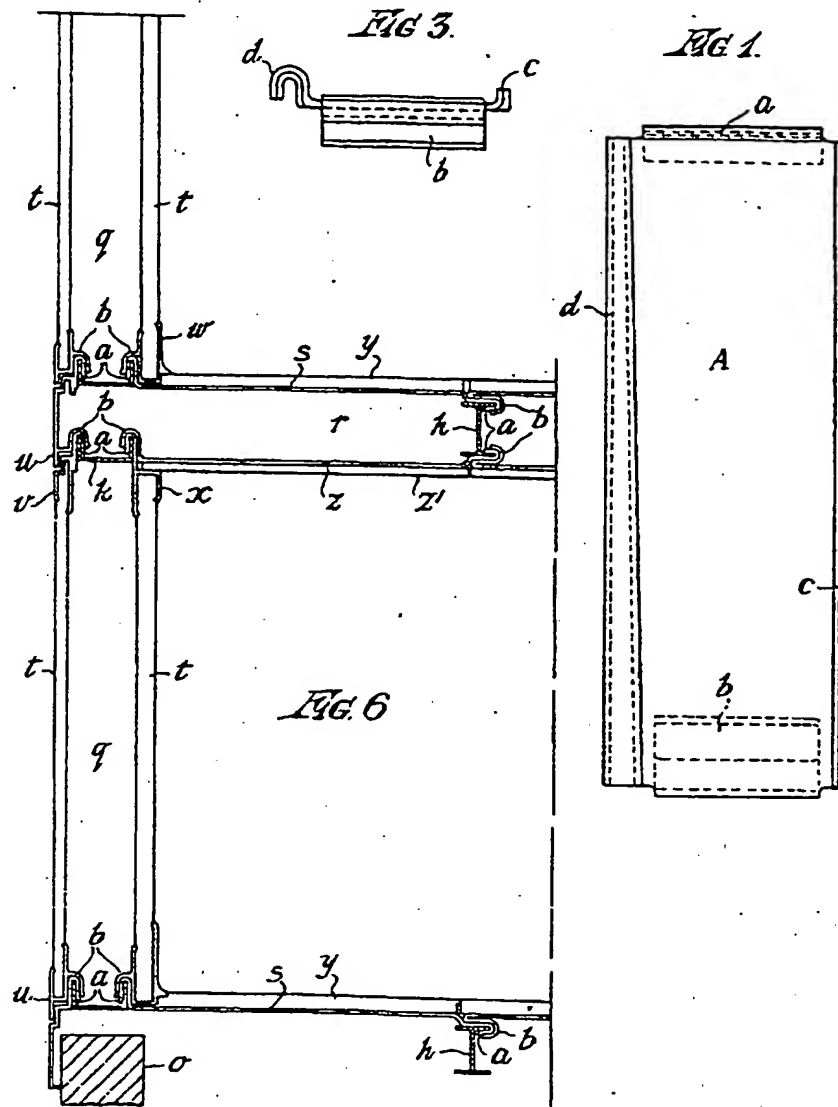


FIG 1.

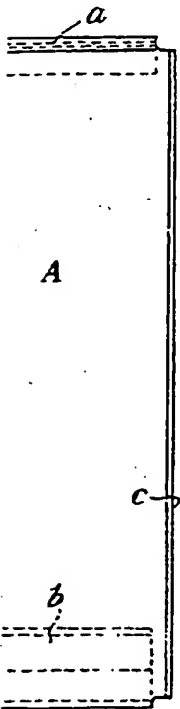


FIG 7.



FIG 2.

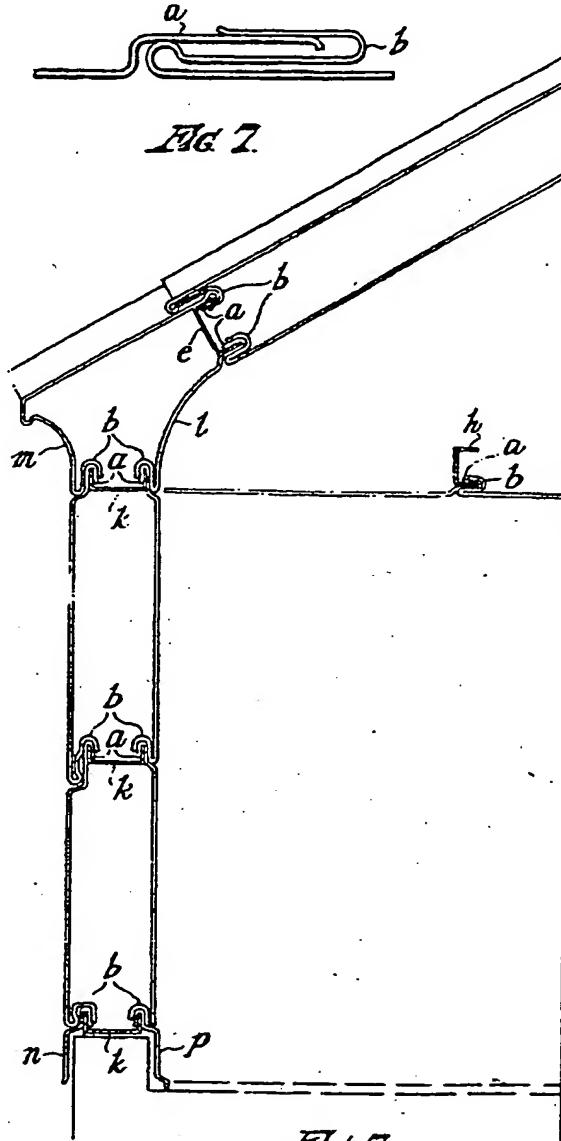
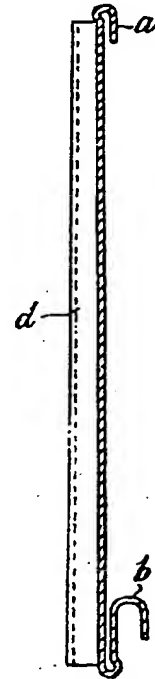
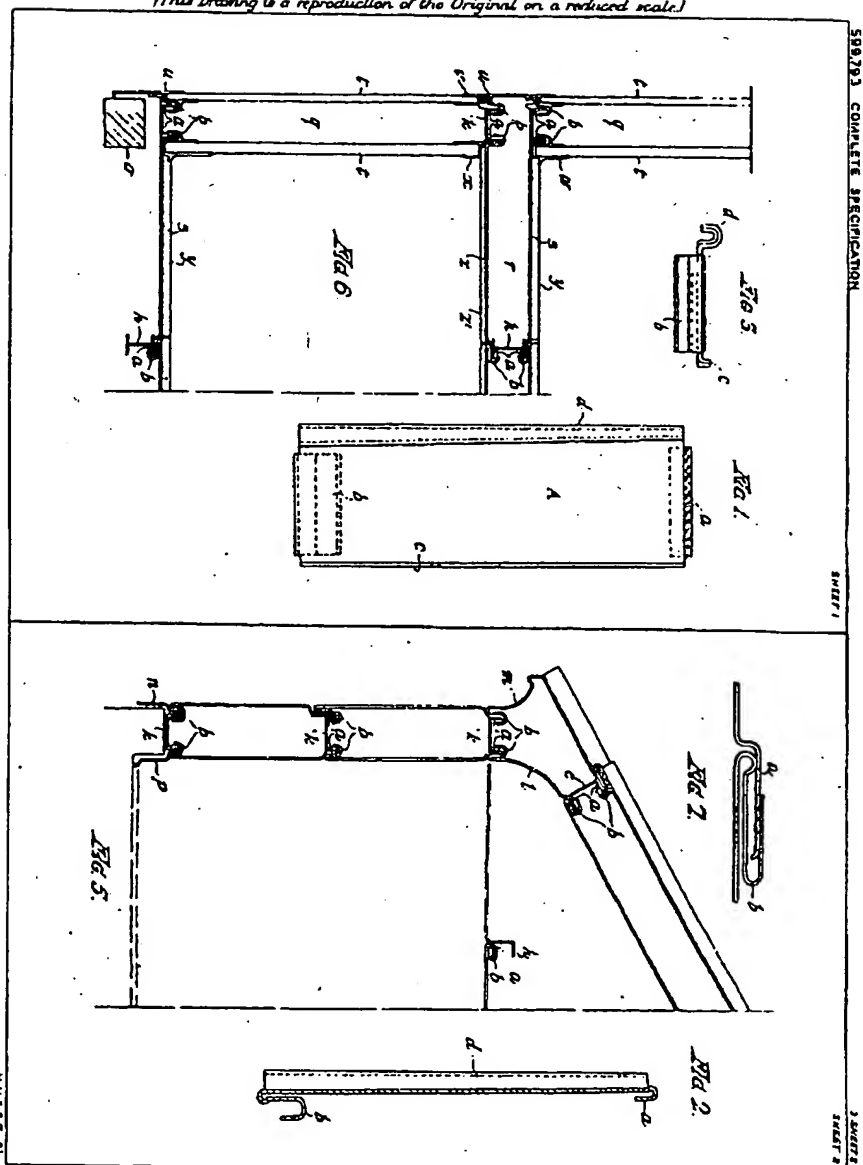


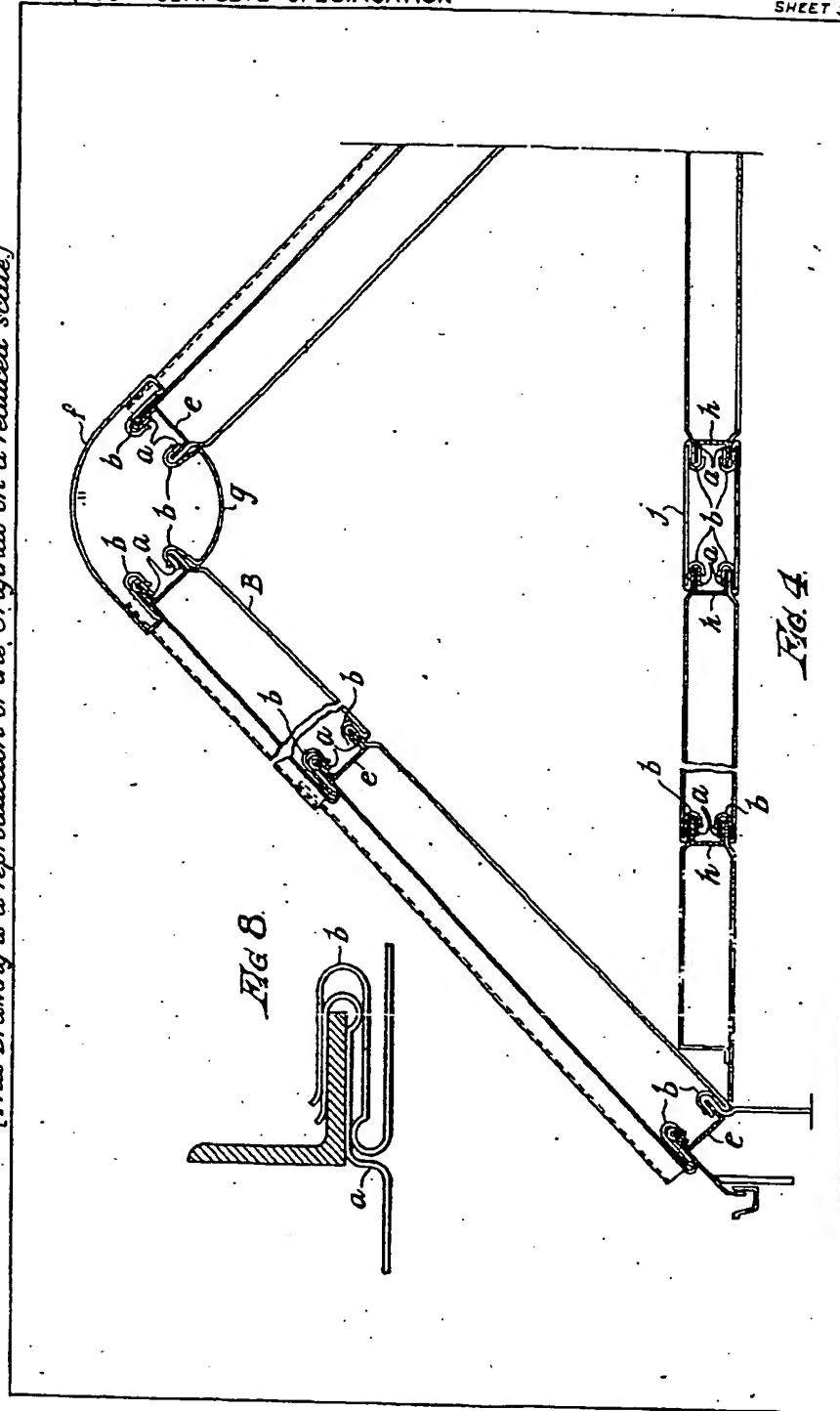
FIG 5.



599,793 COMPLETE SPECIFICATION

3 SHEETS
SHEET 3

[This Drawing is a reproduction of the Original on a reduced scale.]



H.M.S.O. (77. R)

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